GREENWICH WATCH AND CHRONOMETER TRIALS.

"WHAT is the chief end of an astronomer?" is not so stereotyped a question as the corresponding conundrum respecting the chief end of man. This question is, however, suggested by the following statements in the last annual report of the Astronomer Royal to the Board of Visitors:—"In the year ending 1910, May 10, the average daily number of chronometers and watches being rated (at Greenwich) was 596." "The number of Government marine chronometers and watches now at the Observatory is 455." "For the annual trial of chronometers . . . 66 . . . were sent in . . . 8 were purchased for the Navy and 4 for the Indian Government." "For the annual trial of chronometer watches . . . 173 . . . were entered . . . and . . . 35 were purchased for the Navy." In addition there was a trial of pocket chronometers, seventeen being sent in and two purchased for the Navy. The average number of chronometers rated daily has, we learn, more than trebled since 1880, so that the burden of this work borne by the Observatory has enormously increased. The work is doubtless most valuable for the Navy, but is our great national Observatory exactly the place where it should be done?

The question is many-sided. Science for its own sake is regarded by the multitude as a most excellent occupation for wealthy amateurs, but a State-supported institution is expected to devote itself to immediately-practical ends. From this point of view it is only work such as supplying the national time and rating the national chronometers that justifies the existence of Greenwich. There is thus some reason to fear that if this and other obviously useful work ceased, the continuation of the financial support from Government that enables the Observatory to carry out work that is more directly astronomical might be jeopardised. On the other hand, whatever adds to the burden of routine and administrative labour borne by the Astronomer Royal, must reduce the time and energy which he can devote to what is purely scientific.

There are several points of interest in the details of the trials. The box chronometer trial lasted twenty-nine weeks, from June 19, 1909, to January 8, 1910, the temperatures to which the chronometers were exposed varying from 45·8° to 105·6° F. The chronometers are arranged in order of merit according to the value of $a+2b$, where a is the difference between the algebraically greatest and least of the weekly rates, and b the greatest difference in rate between two successive weeks. As in golf, the lowest score is the best. Pocket chronometers and chronometer watches are let off with an eighteen-week trial, notwithstanding the fact that, unlike the box chronometers, they are tried in a number of positions. Their place on the list is determined by a formula which takes account of the differences between the rates in the several positions. Even eighteen weeks is a long time compared to the duration of watch trials at the Swiss observatories, at Besançon or at Kew.

The chief obstacle to uniformity of rate, especially in box chronometers, is the effect of temperature, but a much shorter trial than twenty-nine or eighteen weeks would suffice to test the behaviour of the temperature compensation. The main object, presumably, in having so long a trial is to afford an opportunity for any weak point to declare itself. On this question one would like to know the views, both of the makers and of the Observatory authorities. A long trial means a lock-up of capital, which must presumably have an effect on the cost, especially as only a fraction—in the present case apparently only a small fraction—of the chronometers and watches were actually purchased for the Navy. In the present day, with the increase of speed, a ship is seldom isolated for any great length of time, and the breakdown of a single chronometer is unlikely to be a serious matter. Thus the case for a long trial does not seem so strong as it may have been a generation ago. Very probably ere long the development of wireless telegraphy may alter the whole situation.

NOTES.

A FINE specimen of a rare class among the scientifically eminent passed away when the Rev. Robert Harley, F.R.S., died on July 26, in his eighty-third year. Many friends will miss his hale face and hearty greeting at meetings of the Royal Society; and few of them can have had any idea that one so keen in his interest could be an octogenarian. Mathematics with him was a parergon, almost a hobby. He achieved distinction in it in early middle life, pursuing it in scanty intervals of leisure secured without neglect of engrossing non-scientific duties. The son of a Methodist minister, he had no early mathematical training. At the age of twenty-three he entered Airedale College as a student of theology, and shortly afterwards he was ordained as pastor of the Congregational Church at Brighouse, Co. Yorks. Here he found time to become a mathematician of mark. The application of mathematics to logic as developed by George Boole captivated his intelligence, and he became the most notable of Boole's admirers and followers, as also his biographer. His greatest mathematical achievements were, however, in another field. The unsolved problem of the solution of quintic equations fascinated him. Having once granted the impossibility of the solution by radicals, he proceeded to exhibit with remarkable power and patience the place of certain sextic resolvents in connection with such equations. Simultaneously, the late Sir James Cockle was engaged on like work; but Harley was the clearer writer on the difficult subject. Their work, and in particular Harley's, was welcomed enthusiastically by Cayley, who himself took it up and continued it. All three probably were not aware at the time that certain Continental writers had possessed some of their ideas beforehand; but everyone must recognise that Harley's development of the ideas was masterly. It secured for him the Fellowship of the Royal Society in 1863. Since then, as before, he carried on mathematical research only in such time as was allowed by devotion to pastoral, philanthropic, and temperance work. He laboured in Leicester, Oxford (where he was an original member of the Oxford Mathematical Society, and was given the honorary degree of Master of Arts by the University), Halifax, and elsewhere. From 1872 until 1881 he was vice-principal (and chaplain) of Mill Hill School. For the three years before his removal to Oxford in 1886 he was principal of Huddersfield College. In 1890 he took a period of rest (with pastoral work) in Sydney, Australia. Since 1895 his life was one of retirement, but far from one of inactivity, whether religious, benevolent, or scientific.

THE Berlin correspondent of the *Times* announces the death, in his seventy-sixth year, of Prof. A. Michaelis, who until three years ago was, since 1872, professor of classical archæology at Strassburg University. In addition to being the author of a large number of works on archæological subjects, Prof. Michaelis organised the admirable archæological museum of Strassburg University.

WE learn from *Science* that Dr. Frank H. Bigelow has resigned his positions in Washington, D.C., as professor of meteorology, U.S. Weather Bureau, and professor of astrophysics, George Washington University, in order to travel in Europe for a few months. He will then resume his studies in solar physics and terrestrial meteorology.

IN view of the removal of the work of the Meteorological Office to the new building in Exhibition Road, South Kensington, which is being arranged to take place in the autumn, Mr. R. G. K. Lempfert, superintendent of statistics, has been appointed by the Meteorological Committee to be superintendent of the forecast division; Mr. E. Gold, fellow of St. John's College, Cambridge, Schuster reader in dynamical meteorology, has been appointed superintendent of the statistics and library division; Mr. R. Corless has been reappointed special assistant to the director, with additional duties as secretary and clerk of publications. The appointments date from October 1.

APROPOS of Prof. W. J. Pope's discourse on "The Chemical Significance of Crystal Structure" at the Royal Institution, a full report of which appeared in last week's number of NATURE, it may be noted that the models which illustrated the lecture, together with explanatory labels, are exhibited by Prof. Pope in the Crystallography Section of the Science Hall at the Japan-British Exhibition. Next to this exhibit will be found also models of Bravais's fourteen space-lattices, and of certain of Sohncke's point-systems shown by Prof. H. L. Bowman. Among other interesting exhibits in the same section, in addition to those referred to in an article in NATURE of July 28, may be mentioned the series of goniometers, showing the great change that has taken place in the form of the instrument since it was first devised, the refractometers and protractors, and the pictures, obtained in natural colours by direct photography on autochrome plates, of the interference figures displayed by certain crystal-sections.

IN *L'Anthropologie* for May–June M. Louis Seret brings to a close his essay on the colonial empire of the Phœnicians. To this he attributes the spread of Neolithic culture in western Europe. In the sixteenth century B.C., the Phœnicians, after the first Egyptian incursions into Asia, started on their maritime career. The period of constant warfare which succeeded produced a demand for large supplies of arms of bronze, and the Cassiterides were the only source from which tin in the necessary quantity could be provided. But the accessible mines soon became exhausted, and in the twelfth century the increasing use of iron made the bronze trade much less important. He connects the menhirs of western France with the cult of a deity of reproduction, like the Greek Hermes. These brilliant generalisations will probably not meet with universal acceptance; but this important study throws new light upon the connection of the Phœnicians with the spread of Neolithic culture in western Europe.

IN a third instalment of a "symposium" on the palæontological record, published in the August number of the *Popular Science Monthly*, Prof. R. S. Lull discusses the relation of embryology and vertebrate palæontology. He mentions that the dinosaur Compsognathus was probably viviparous, and refers to the importance of ascertaining the origin of the peculiarity that the presumed ribs of chelonians are external to the limb-girdles. He also comments on the similarity between the head of a fœtal manati and that of a modern ungulate.

IN the course of a note on the first skull of the species obtained from the Pleistocene of Saxony, Dr. K. Wanderer, writing in *Sitzungsberichte und Abhandlungen der naturwis. Ges. Isis* for 1909 (1910), reviews recent literature relating to the local races of the musk-ox. In 1908 Dr. R. Kowarzik pointed out that the living representatives of the species are divisible into two main groups—an eastern and a western—distinguished by skull characters. The line of division between the two types is formed in North America by the Atlantic watershed and its continuation in the islands of the Arctic Ocean. The western type, *Ovibos moschatus mackenzianus* (of which Gidley's *O. yukonensis* appears to be a synonym), inhabits the Mackenzie Valley and the districts to the west, but appears to have been originally a native of Europe and northern Asia, whence it reached America by way of Bering Strait. The skull is characterised by the nearly quadrangular outline of the basioccipital, the flattened but large horn-bases, the close approximation of the stout sheaths of the horn-sheaths to the forehead, the presence of distinct lacrymal pits, the marked curvature of the tooth-line, and the long interval between the sphenomaxillary fossa and the last molar. The eastern American form is, it may be presumed, *O. m. typicus*, allied to which is the Greenland *O. m. wardi*. The skull described by Dr. Wanderer was obtained from Prohlis, near Dresden, in association with remains of *Rhinoceros antiquitatis*, and is referred to the western form.

TWO volumes by Mr. J. Wright on the cultivation of allotments have lately been added to the series of "One and All" garden booklets. The first supplies information with regard to the preparation and improvement of the soil; the second deals with the production of vegetables, fruits, and popular flowers.

A NEW volume, the fifth, of the botanical section of the *Philippine Journal of Botany* begins with a number devoted to the first part of an enumeration of Philippine Leguminosæ, provided with keys to the genera and species, for which Mr. E. D. Merrill is responsible. The enumeration covers 90 genera and 285 species, of which 14 entire genera and 53 species are considered by the author to be introductions. The proportion of endemic species is low as compared with many other families. None of the genera are very large, Desmodium being predominant with twenty-nine species, while Monarthrocarpus and Luzaria are monotypic and endemic. Several species yield valuable timbers, notably *Pterocarpus indicus*, *P. echinatus*, *Albizzia acle*, *Intsia bijuga*, and *Pahudia rhomboidea*.

A NOTE by Mr. W. R. G. Atkins on the cryoscopic determination of the osmotic pressures in some plant organs, chiefly fruits, appears in the Scientific Proceedings of the Royal Dublin Society (vol. xii., No. 34). Following the methods adopted in earlier experiments, the osmotic pressures were calculated from the data obtained by measurement of the freezing point of the expressed cell sap. The values so obtained justify the deduction that similar organs of any plant species have approximately equal osmotic pressures, although a wide range of values is obtained for similar organs of different plants. Thus tomato fruits gave a value varying from six to nearly eight atmospheres, and greengages a pressure of twenty-nine atmospheres. The variation in pressure recorded for the tomato is connected with the ripening of the fruit, the lower pressure in this case referring to the ripe fruit, and is accounted for by the chemical changes in the cell sap.

BULLETIN No. 55 of the West of Scotland Agricultural College contains an account of experiments on soil inoculation for the lucerne crop. Lucerne is not at present

cultivated in Scotland, and the necessary bacteria are presumably not present to any great extent in the soil. Addition of the organisms by inoculation has proved successful.

THE changes taking place during the storage of butter have been investigated at the Michigan Agricultural College Experiment Station by Messrs. Rahn, Brown and Smith. There was a distinct increase in the non-protein nitrogen, indicating a certain amount of proteolysis, but the exact agent was not determined. There were, however, micro-organisms found multiplying even at −6° C., whilst a torula proved extraordinarily resistant to salt, even growing in a 25 per cent. salt broth.

THE use of insecticides containing arsenic appears to be attended with considerable disadvantage in India, and experiments have for some time past been carried out at the Agricultural Research Station, Pusa, with the view of discovering some other compounds equally effective. Lead chromate was finally selected; being yellow, it is easily visible on the plant; it does not burn the foliage, and it adheres well. A suspension of 1 lb. in 64 gallons of water proved effective on plants that are being attacked, while 1 lb. in 100 gallons of water proved a sufficient preventive.

A RECENT circular of the Royal Botanic Gardens, Ceylon, contains an account, by Mr. Petch, of the root disease of the cocoa-nut palm caused by the fungus *Fomes lucidus* (Leys). No method of curing a diseased tree is known; once a tree is attacked there is little hope of saving it unless some only of the roots are affected and can be cut off. This only rarely happens, and it is usually best to fell the tree at once. Methods of treatment are badly needed for cases such as this; there seems to be no prospect of successful treatment by the internal application of a fungicide, since the tree is more easily killed than the fungus.

The renewed interest now being taken in the United States in all questions affecting natural resources, and particularly the soil, is reflected in the articles in the *Popular Science Monthly* (No. 6). Dr. McGee describes the scientific work of the Department of Agriculture, which includes more than half of the official bureaus in the States. Prof. Brigham gives a popular account of soil formation and of weathering, and shows how such apparently trifling details as the lowering of the level of water in the soil through the operations of man may in course of time lead to profound changes. There is also a well-illustrated paper by Prof. Herrick on instinct and intelligence in birds.

THE July number of the *Journal of the Board of Agriculture* contains a paper by Messrs. Robinson and Watt describing the Coombe plantation, Keswick, which was planted in 1848, and is now being cleared. It is remarkable in that careful accounts have been kept of all costs and of all returns, and further in that experimental groups of trees have been periodically measured. A discussion of the data is given, and there are a number of good photographs. Another paper, by Mr. A. B. Bruce, aims at giving the stock-breeder a general account of Mendelism which should go far to satisfy him that the scientific treatment of his problems is likely to lead to valuable results.

RECENT bulletins from the United States Department of Agriculture Bureau of Entomology deal with (1) the western grass-stem saw-fly (*Cephus occidentalis*, Riley and Marlatt), which causes trouble to the wheat-growers of North Dakota and elsewhere; (2) the woolly white-fly (*Aleyrodes howardi*, Quaintance), a new enemy of the Florida orange, which hitherto has only been known to infest orange trees in some of the West India islands, and especially Cuba; (3) the oyster-shell scale (*Lepidosaphes ulmi*, L.) and the scurfy scale (*Chionaspis furfura*, Fitch), now very generally distributed through the States, and sometimes confounded with the more serious San José scale; although they do not actually kill the trees, they cause serious financial loss; (4) the "brown rot" (*Sclerotinia fructigenia*, P. Schröt.) and plum curculio (*Conotrachelus nenuphar*, Herbst.) of fruit trees; the former is a fungus disease of the flowers, twigs, and fruit, especially harmful at the time of ripening; the latter is an insect that, in the course of its feeding and egg-laying, punctures the fruit, often so copiously that much loss is suffered; (5) the sorghum midge (*Contarinia* [*Diplosis*] *sorghicola*, Coq.), which is by far the most destructive agent affecting sorghum. A general description of the insects attacking crops in Michigan is issued by the Michigan State Agricultural College Experiment Station; the bulletin is well illustrated, and contains a considerable amount of useful information.

MESSRS. BURROUGHS, WELLCOME AND CO. have issued, in connection with their exhibit at the Japan-British Exhibition, an illustrated descriptive pamphlet (in English and in French) of the Wellcome Physiological Research Laboratories and of the work done there. This includes the preparation and standardisation of diphtheria antitoxins and other therapeutic sera, bacterial vaccines, the physiological standardisation of drugs such as ergot, &c.

THE fourth annual report of the Metropolitan Water Board, by Dr. Houston, on the results of the chemical and bacteriological examination of London waters for the year ending March 31 last, has recently been issued. It contains a mass of figures relating to the bacterial content and chemical composition of the raw, stored, and filtered water supplied to the metropolis, valuable on account of the systematic examination of the water and as showing how our water supply is, so far as possible, safeguarded. Dr. Houston again insists that the *raw* waters are undoubtedly unsatisfactory in quality, but that storage with sedimentation effects a considerable improvement, and he emphasises the supreme importance of storage as a means of preliminary purification of the raw water.

THE new catalogue of the Cambridge Scientific Instrument Co., describing Duddell oscillographs, gives particulars of the latest type of these instruments. The improvements incorporated in this instrument include greater accessibility and ease of repair of the vibrators and alteration of the design in such a manner as to prevent the leakage of oil from the damping chamber, which was such an unpleasant feature of the old type. Particulars are given of the accessory apparatus required and of the methods of using the instrument, and an appendix contains reproductions of a number of interesting records of wave shapes.

WE are in receipt of a copy of the "Catalogue of Mechanical Engineering and Electricity," containing information concerning the British exhibits in these sections at the Brussels Exhibition. The preface is written by Prof. W. C. Unwin and Mr. John Goodman, and gives a summary of the progression and tendencies of engineering science as exemplified by the exhibits referred to in the

body of the catalogue. The nine sections include mechanical engineering, electricity, civil engineering, agriculture, horticulture and arboriculture, food products, mining and metallurgy, textile industries, and chemical industries. A plan at the end shows the positions of the stands of the various exhibitors.

THE *Physikalische Zeitschrift* for August 1 contains a review of the present state of our knowledge of the properties of the α particles sent out by radio-active substances, by Dr. H. Geiger, of Manchester. The velocity of the homogeneous rays sent out by radium C appears to be $2{\cdot}06\times10^{9}$ centimetres per second, and the quotient of the electric charge by the mass $5{\cdot}07\times10^{3}$ electromagnetic units. The mean number of α particles sent out by a gram of radium per second is $3{\cdot}1\times10^{10}$, and each carries a charge 9·3 to $9{\cdot}6\times10^{-10}$ electrostatic units, and appears to be a helium atom. The progress of each is checked by the molecules of a gas, and in air the path described does not exceed a few centimetres in length. During the description of this path each is capable of producing $1{\cdot}72\times10^{5}$ ions by collision. The results of the recent measurements of the diminution of the velocity of the particles as they pass through solids, their scattering, and their ultimate absorption are all discussed in a clear and thorough manner.

A LETTER from Sir William Ramsay, in the *Chemical News* of August 5, directs attention to a new fact in the history of the development of the Leblanc process for the manufacture of soda. It has generally been believed that Leblanc perfected a process devised by De La Métherie in 1789. A letter to Dr. Black, written by a Mr. Geo. Golder, of Edinburgh, and dated March 19, 1782, shows, however, that the black ash process had already been devised and patented by an English inventor named Collinson. A specimen of black ash prepared by Collinson's process was submitted to Dr. Black, who reported that it contained "more alkali than the best Alicant Barilla in the proportion of 68 to 44, and more than the best kelp in the ratio 68 to 10." "It is an excellent ash for the soap-boilers . . : and there is no need to use lime in drawing the leys from it, as it is already in a caustic state." "After this," the writer adds, "there appears little doubt who invented the black-ash furnace."

MANY examples of smoky chimneys are no doubt owing to carelessness and lack of knowledge in those concerned with the work, but we also find many architects and builders of repute being occasionally nonplussed by the problem. Some important points in chimney design are given in the *Builder* for August 13. The grate should be provided with a blower to induce a good draught at the start. The flue should be expanded laterally to a width of about 2 feet a short distance above the grate, and then brought in again, forming what is usually termed a "bottle." Above this, one or two bends of about 150 degrees should be made. The top should be slightly contracted, and the chimney-cap sloped up sharply all round the aperture or pot; outside chimneys should be avoided; stacks should come as near the highest part of the roof as practicable; a number of flues should not be packed too closely together in a large stack, but kept as distinct as possible; the outer walls of stacks should be 9 inches thick.

IN an article on the International Road Congress, which opened in Brussels on August 1, *Engineering* for August 12 gives the altered form of a rejected resolution, which in its original form condemned macadam. The resolution finally adopted is as follows:—"Macadam, carried out by the methods of Tresaguet and Macadam, causes dust and mud, is expensive to maintain, and is suitable in large cities only for streets where the traffic is not very great or heavy. The experimental work carried out in recent years with macadam, improved by using a bituminous or tarry coating or binder, ought to be continued to determine the best method of utilising this kind of construction under varying conditions, and the results considered at the next congress." Our contemporary directs attention to a point which requires scientific investigation, viz. the exact behaviour of a sand foundation under stone pavement. On the Continent, a bed of sand from 3 inches to 6 inches deep is almost invariably used, and the setts are bedded directly on and in the sand. The sand is spoken of as a "cushion," and is said to be elastic. Another view is that it absorbs the shock on the pavement, saves the stones from damage, and reduces the noise of traffic. It would be easy to settle the points in doubt by experiments in an engineering laboratory.

OUR ASTRONOMICAL COLUMN.

A NEW COMET.—A telegram from the Kiel Centralstelle announces the discovery of a new comet by the Rev. J. H. Metcalf at Taunton, Mass., on August 9. The position, at 9h. 15·2m. (Taunton M.T.), is given as R.A. = 16h. 10m., dec. = 15° 20′ N., and the comet was said to be moving in a south-westerly direction; at the time of discovery the brightness of the comet was about equal to that of an eleventh-magnitude star.

A later telegram gives the position of the comet as observed by Mr. Burton at Boston on August 10; at 12h. 28·8m. (Boston M.T.) R.A. = 16h. 10m. 29·3s., and dec. = 14° 56′ 41″. The comet is on the meridian at about 6h. 30m. p.m.

OBSERVATIONS OF COMETS.—Dr. Max Wolf records an observation of comet 1910*a*, on July 15, in No. 4429 of the *Astronomische Nachrichten* (p. 210). The comet was then a little to the south-east of υ Cygni, and its photographic magnitude was 16·5.

In No. 4430 of the same journal he states that on plates taken on April 11 he has found images of comet 1909*e* (Daniel); the comet was then fainter than Halley's at the time of discovery, and was not shown at all on a plate which had a longer exposure on May 12. In compliance with a request from Herr Jan Krassowski for unpublished observations of comet 1909*e*, Dr. Rambaut also publishes some positions of this comet, secured at the Radcliffe Observatory during December, 1909, and January, 1910.

OBSERVATIONS OF MERCURY.—During July and September, 1909, observations of Mercury were made at the Revard (Aix-les-Bains) and the Massegros (Lozère) observatories by MM. G. and V. Fournier, and the drawings are now reproduced and discussed by M. Jarry-Desloges in the August number of the *Bulletin de la Société astronomique de France*. Those made at Massegros, with a refractor of 29 cm. (11·5 inches) aperture at an altitude of 900 m., show that there are definite markings on the surface of the planet which can be seen and delineated by different observers at different times with striking agreement, although the observing difficulties are very great. A dark patch on the southern horn is shown on all the drawings, and in some even obliterates the actual cusp. Other markings agree on different drawings, and can also be identified with some observed by Schiaparelli and Lowell. The observations confirm the statements that the rotation period of Mercury is probably equal in length to the planet's revolution period.

DISPERSION OF LIGHT IN INTERSTELLAR SPACE.—Recognising the importance of the results obtained by MM. Nordmann and Tikhoff regarding the differential velocities of light of different wave-lengths through interstellar space, Herr Beljawsky made a number of observations of the Algol variable RZ Cassiopeiæ during the autumn of 1909. Using filters which transmitted either visual rays